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Introduction to MIAP

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Out of Order:

Museum Practices and Obsolete Display Technologies

No technology is ahistoric. Any device is inherently linked to a specific time, even place. The design, functionality, and purpose of a device provides insight to the philosophies, economy, and media of the culture that bore it. The very decision to use a technology as a medium for creating art, let alone the resulting works, speaks to the moment of the work's creation. Therefore, the intended equipment employed in an artwork carries with it a myriad of connotations and historical underpinnings, which ground the work in a specific context.

Due to the constant state of change in technology, obsolescence is inevitable. As technology evolves, previous devices will be forsaken for slimmer, faster, cheaper or more convenient ones. However, as technology is incorporated in to works of art, it becomes less ephemeral. The unique properties of a specific devices gain value and significance outside the context of consumer society and mass-production. The inevitability of obsolescence remains, but the stakes have been raised. In particular, the equipment used to display a work, due in part to its necessary proximity to the image, light or "essence" of a work, develops a close association with the work itself. As all technology changes, so must artworks which are reliant on technology. The goal of this paper is to investigate the methodology employed by museums to manage this change,

using display technologies as a lens through which to focus examples and specific practices.

The artist interview has become an essential tool for combating the perplexing eccentricities of conserving media art. The production history of a piece, how it was made, why it was made, what motivated the decision to choose a certain piece of equipment over another, etc., informs a deeper understanding of the essential qualities of a work. Discussing the history of a work can also help an artist ground her interview in familiar territory (as opposed to jumping in to “why did you choose this projector? Why not that projector?” right off the bat). Christine Frohnert, a conservator who specializes in working with contemporary art, feels that:

“Giving the artist time to talk about the piece, in depth, making sure that he has enough time at the very beginning to find his own comfort zone...usually helps provide the best foundation to conduct the interview... and of course all of them like to talk about their artworks.”¹

The necessity of establishing a casual and welcoming atmosphere was echoed by the Museum of Modern Art’s Media Conservator² (MoMA) Peter Oleksik:

“There’s a kind of methodology to interviewing...we’ve found keeping it loose and conversational allows us to get more information because, if you have a set rubric or framework, that you want to go through, you tend to paint yourself into a corner, where you’re kind of prescribing to the artists what they should be doing, when you don’t want to do that.”³

¹ Frohnert, Christine. Telephone interview by author. December 2, 2014.

² “And former MIAP graduate” - Howard Besser

³ Oleksik, Peter. Interview by author. November 19, 2014.

Oleksik's concern about the restrictive nature of a fixed perspective when addressing a broad range of art is well taken. Certainly, the unique qualities of an artwork must be respected. Conservation of electronic media art should be handled on a case-by-case basis. That being said, the avoidance of a "rubric or framework" is not a uniformly adopted procedure.

Beginning in 2012, the Los Angeles County Museum of Art (LACMA) adopted the use of a "Time Base Media Questionnaire" as part of the museum's acquisition process. The 4-page document has over 30 questions ranging from specific information about the aspect ratio of any video component, to open ended requests for "a non-technical description of what the viewer experiences." The potential obsolescence of display equipment is addressed specifically, "In case of equipment obsolescence, LACMA may find it necessary to replace vintage equipment with newer components. Is this acceptable to the artist?" but also more broadly through questions about the role of the equipment, "Is it purely functional or does it have a conceptual or aesthetic significance?" and why it was selected "What important features or qualities have led to this choice of equipment?"⁴ Obviously, not all of these questions will apply to all artworks, and "N/A" is a typical response on the questionnaire, but unfortunately, applicable questions are sometimes not answered by the artist or her staff. This is the questionnaire's greatest weakness.

The Variable Media Questionnaire can be seen as an "in between" or "happy medium" to MoMA and LACMA's varying approaches. The Variable Media Network, founded by the Berkeley Art Museum/Pacific Film Archives, Franklin Furnace, Guggenheim Museum, Daniel Langlois Foundation for Art, Science and Technology,

⁴ LACMA Time Based Media Questionnaire

Performance Art Festival + Archives, Rhizome.org and the Walker Art Center, is a collaboration between art institutions to better define methodologies for the treatment and preservation of media artworks.⁵ The Variable Media Questionnaire (VMQ) now exists as a web-based application with a modular interface that divides works into “parts,” which are then further delineated into categories like “material,” “environment,” “source,” and more. These modules allow for a user to link variable components of a work together while, if the interviewer chooses, addressing specific issues of a particular component independently. A unique feature of the VMQ interface is the ability of the interviewee to gauge the “strength” of his views on a given decision, which creates an opportunity to provide a full-throated response while still allowing for flexibility. Furthermore, the VMQ allows for both interviews, and more relevantly, interview questions and composition to be shared with users of the application, creating a shared source of knowledge and practice.⁶

It would be difficult to argue that a framework for conceptualizing unique artworks is not inherent to the application. The view of a work as a combination of components of varying significance, with fixed treatment methodologies such as storage, migration or emulation is incorporated into the structure of the interface. Additionally, all fields of a given module must be filled in order to complete any step of the process. A more flexible interface which still allowed for the benefit of the Variable Media Network’s framework for conceptualizing media art would be prudent. However, the VMQ is designed to complement a formal exchange between a stakeholder, be they a

⁵ "Variable Media Network." Variable Media Network. Accessed December 11, 2014. <http://www.variablemedia.net/e/index.html>.

⁶ Ippolito, Jon, Alain Depocas, and John Bell. "VMQ Beta 0.43." VMQ Beta 0.43. Accessed December 11, 2014. <http://variablemediaquestionnaire.net/demo/>.

conservator, curator, gallerist, etc., and the artist, artist's representative or expert, a most important step in developing a deeper understanding of an artwork.

The collaborative nature of the Variable Media Network and subsequent Questionnaire is clearly beneficial, as arts institutions often lend works to one another, garnering a need for a shared understanding of treatment and installation of complex works. Lending practices was the initial topic covered by the Matters in Media Art project, another collaboration between arts institutions aimed at codifying museum practices regarding time-based media artworks. A joint project between MoMA, Tate, and the San Francisco Museum of Modern Art (SFMOMA), the 2005 Matters in Media Art online publication details ideal expectations from both a borrower and owner of a work, including documentation guidelines (for the owner), best practices for condition reporting, and a clear emphasis on the need for research and an in depth understanding of the work by the borrower. A subsequent 2008 publication details a similar process for acquiring time based media works.⁷ Representatives from the respective institutions still have a weekly phone call regarding updates to the Matters in Media website (hosted by Tate.org).⁸

Both the Variable Media Network and the Matters in Media Art project emphasize the need for an informed perspective on a given artwork before beginning preservation practices or even installation. Indeed, developing and managing a thorough understanding of an artwork's essential qualities, and allowing for an evolving understanding of these qualities over time, can be seen as the key component in the

⁷ "Matters in Media Art." Tate. Accessed December 11, 2014.
<http://www.tate.org.uk/about/projects/matters-media-art>.

⁸ Oleksik, Peter. Interview by author. November 19, 2014.

conservation of electronic media art. Artist interviews certainly aid with this process, but an artist's perspective, at any given moment, can not be seen as a "silver bullet" of understanding a work.

Conservator Christine Frohnert cautions against placing restrictions on possibilities of a fully realized work too soon.

"[Artworks] sometimes need to be installed several times before they develop this sort of authority because the artist is really a little uncertain how to show it best... I think within these early days of the birth of an artwork this is not only acceptable, this is part of the creation of the piece to allow this to unfold a little bit over time."⁹

The inverse of this is also true, however. An artist can become distanced from a work over time, and their perspective on their work can shift.¹⁰ As one of the goals of conservation of this type of work is to respect the historic moment a work was created in, significant changes to a piece years after its initial conception can be problematic. The value of a work is, in part, its position on the historical spectrum of art practice. By removing a piece of equipment that anchors a work to a historical moment there is a danger of removing the work from its context. Understanding the weight of any particular piece of equipment and its role in the work is, again, a mechanism of thorough research. One must have a deep understanding of the historical role of a technology, and a sophisticated conversancy in the technical requirements and functionality of the

⁹ Frohnert, Christine. Telephone interview by author. December 2, 2014.

¹⁰ Frohnert, Christine. Telephone interview by author. December 2, 2014.

"[The artist] has moved away probably from that piece and his judgement might be not the same as it was...If the work is a little older, I would be hesitant to allow the artist to propose to many changes."

equipment in question, to be able to make an informed decision about the importance of its role in an artwork.

To that end, a brief history and description of two, now obsolete, display technologies is described here. This by no means is meant to be an exhaustive archeology of either of these types of equipment, nor a comprehensive description of conservation methods related to them, but merely an example of the types of challenges one encounters when working with obsolete display technologies in a museum context, and solutions put forth by experts in the field.

Slide Projectors

A slide projector is a broad term for a mechanical device that passes light through a transparent image and optics to create a projected still image. However, the term slide projector is most often used to refer to 35mm slide projectors, which became popular for domestic and educational use in the mid 20th century. Kodak's first slide projector, the Kodaslide, was released in 1937, with subsequent models (Model 1a, Master Model, Merit, etc.) released until 1958. The Kodaslide model used 2" x 2" slides, displayed one at a time. With the exception of the first model (1937-1940), feeding a new slide into the Kodaslide would force the previous one out.¹¹ The ubiquitous Kodak Carousel projector was released in 1961, allowing users to load up to 81 slides in a circular compartment, that could then be advanced manually or automatically in 5-, 10-, or 20-second intervals.¹² The Kodak Company's "A Brief History of Slide Projectors" notes, in bold,

¹¹ Crosby, Josh. "My New 1951 Kodak Kodaslide Merit Slide Projector." YouTube. October 30, 2011. Accessed December 11, 2014. https://www.youtube.com/watch?v=ZJVIV_npZo.

¹² "The Evolution of Kodak Ektagraphic Slide Projectors." Accessed December 11, 2014. http://resources.kodak.com/support/pdf/en/manuals/slideProj/02_SlideProjectorSourceBo

red type, that the release of the Carousel projector was “Revolutionary!”¹³ And indeed, the whirl of the projector’s fan, the hum of the bulb, and the iconic “ca-chunk” of the slide advancing immediately evoke a specific sense of presentation that artists find essential.

Conservator Ainsely Walton, presenting at the Documentation and Conservation of Media Arts (DOCAM) annual summit in 2007, observed:

“Digital projection and slide projectors produce quite different aesthetic results. Walking into a gallery space with a slide projector sitting there, whirring and clicking away, is quite a different experience than walking into a room where there are photographs being projected by a digital projector. The historical context of the medium is lost, as well as the what has been described as that kind of “ghost in the machine” aesthetic.”¹⁴

Because of this intrinsic aesthetic difference, conservators have made great efforts to preserve slide-based artworks in their original format. Walton, for example, procured 11 duplicate sets of slides for artworks which use carousels (“10 for future exhibitions plus a designated sub-master”), and, for artworks that only use one slide, projected for hours at a time, 50 duplicates were made for future exhibitions.¹⁵

Conservator Tina Weidner has thoroughly documented the Tate Museum’s herculean effort to preserve 35mm slides. Beginning in 2007 Weidner began to assess the

[ok_partI.pdf](#).

¹³ “Brief History of the Museum.” Philadelphia Museum of Art Bulletin 59, no. 279, Education in the Museum (October 01, 1963): 6-7. Accessed December 11, 2014. <http://www.kodak.com/eknec/documents/a6/0900688a807890a6/history.pdf>.

¹⁴ Walton, Ainsley. “Ainsley Walton, Conservation and Preservation Committee.” DOCAM. 2007. Accessed December 11, 2014.

<http://www.docam.ca/en/component/content/article/75-comite-conservation-et%20restauration.html>.

¹⁵ Walton, Ainsley.

state of commercial analog slide duplication, the feasibility of small-scale and in-house slide duplication, and the limitations of digital intermediates. While Weidner's efforts and expertise are inspiring, the results of her survey could be seen as disparaging.¹⁶ After working with a variety of laboratories in London, it was determined that commercial slide reproduction was not of a caliber necessary to meet the needs of an art conservation department (color, contrast, and grain must be reproduced to a very high standard to maintain the integrity of the work).¹⁷ This experience was echoed by Ainsley Walton, at the time working at the National Gallery of Canada, who received unsatisfactory results from two labs that specialized in slide duplication in Ottawa in the early 2000s. Walton eventually found a suitable lab in Toronto, where she had the aforementioned multiple sets of duplicates created, to stave off obsolescence.¹⁸

The process of stockpiling slides and slide projectors is not uncommon. LACMA currently holds close to 300 slide projector bulbs in storage, multiple boxes of lenses for slide projectors and close to 20 slide trays.¹⁹ While the obsolescence of this technology is inevitable, Christine Fronhert suggests that the current practice is to hold off for as long as possible:

¹⁶ I refuse to see the inevitable growth and change of technology as "sad." All forms of technology are intrinsic to a moment in time and will therefore always become obsolete eventually. However, I understand one's love for a given type of equipment, and recognize that sometimes technology that delivers superior quality is forgotten for an "equivalent" that cannot produce the same results. This is certainly true for slide projectors when compared to digital projectors. Unfortunately conversations about bygone technologies have a tendency to resemble statements that begin with "kids these days and their..." and feel a bit pessimistic.

¹⁷ Weidner, Tina. "Dying Technologies: The End of 35 Mm Slide Transparencies." Tate. 2012. Accessed December 11, 2014. <http://www.tate.org.uk/about/projects/dying-technologies-end-35-mm-slide-transparencies/diary-working-activity-slide-lab>.

¹⁸ Walton, Ainsley.

¹⁹ LACMA AV Equipment Inventory

“We will lose that fight at some point. I’m not ready for it. We have been lucky enough to find people who can still work with us on slide based pieces... there are no more Kodak service centers for slide projectors anymore so we’re trying to wrap our minds around this as good as we can and purchase replacement components and bulbs as best we can. So we are trying to push this decision to our successors, I guess (laughs).”²⁰

After ruling out commercial slide duplication, Tate then turned to the photography department’s Firenze ChromaPro 45 slide duplicator, to attempt to create duplicate slides using photochemical process. Working with Rod Tidnam, a Tate photographer, Weidner developed an in-house workflow using the slide duplicator. While time-consuming and labor-intensive, this process was successful, until Fuji discontinued its production of slide duplicating stock in 2009, and Kodak announced they would do the same in March of 2010. As a result, Tate changed the approach and began to stockpile Kodak Edupe, Fuji CDUII and Agfa Scala b/w negative film.²¹

It was around this time that Tate began working with Activity Photo Lab in Esslingen, Germany. Run by the husband and wife team of Elke and Jochen Trabandt, Activity Lab has also worked with MoMA in the last year, to create “four or five sets” of duplicate slides for a recent exhibition of the photography of Allan Sekula.²² Using 70mm slide duplication stock and a Forox Trick Camera,²³ Activity is able to very

²⁰ Frohnert, Christine. Telephone interview by author. December 2, 2014.

²¹ Weidner, Tina. "Dying Technologies: The End of 35 Mm Slide Transparencies." Tate. 2012. Accessed December 11, 2014. <http://www.tate.org.uk/about/projects/dying-technologies-end-35-mm-slide-transparencies/diary-working-activity-slide-lab>.

²² Oleksik, Peter. Interview by author. November 19, 2014.

²³ Jochen Trabandt purchased the Forox in 1986, for \$150,000. With great foresight he quickly purchased three more and ten replacement color heads.

precisely custom duplicate and cut slides to order. As a small business in a niche market, Activity can budget time and expertise to the sensitive needs of museums and artists, modifying their equipment or milling and stenciling unique slide mounts as needed.²⁴

With the exception of recently working with Activity, which conservator Peter Oleksik admits is “probably the last time we’ll get that,” MoMA primarily has slides produced through digital intermediates. Slides are scanned or photographed differently depending on the work. For example, MoMA worked with Chicago Albumen Works, confusingly located in Massachusetts, to create exhibition copies of a slide based work by Luther Price.

“[Price] often presses other things between the two glass plates of the slides, projecting ants, dirt, and adhesive materials onto the gallery wall. Like his films, these slides are studies of a dying technology, pushing and exploring the qualities of light projected through and onto a variety of transparent, semitransparent, and opaque materials”²⁵

To reproduce these collages of materials, Albumen Works photographed the slides and produced a variety of duplicates, from which Oleksik chose the most suitable. Additional slides are then produced by Albumen from 4000 dpi .tiff files, one set for every month a work is on exhibition.²⁶

The Tate, MoMA, the National Gallery of Canada, and Christine Frohnert’s private practice, have all gone to great lengths to ensure that works originally intended for display on slide projectors can continue to be exhibited in this form for as long as

²⁴ Weidner, Tina.

²⁵ "Luther Price." Whitney Museum of American Art. 2012. Accessed December 11, 2014. <http://whitney.org/Exhibitions/2012Biennial/LutherPrice>.

²⁶ Oleksik, Peter. Interview by author. November 19, 2014.

possible. It is worth noting, however, that some artists do not share this level of concern about the display technology employed in their work (some certainly do). Ainsley Walton described an interview with Garfield Smith, concerning his work *Notes on White*, which is displayed using 1200 slide and 5-10 projectors. The artist stated he would be

“fine with the artwork being presented digitally because it would be easier to install, and he did not think the slide projector or its noises were essential or even relevant to the work.”²⁷

Eddy Vajarakitipongse, Technical Manager of LACMA’s time-based media department recalled a recent acquisition in which the artist stated that he

“would prefer to show this as analog slides, but at the same time, he also gave us permission to digitize the slides so that, in the future, when slide projectors are not readily available, or too hard to source, then we can show digital. But the requirement, this guy was smart, the requirement is that the digital slides must be an equivalent resolution to his analog slides, which means that we will have to be at 4k and up. The...sound [of the projector] wasn’t the important part in this case.”²⁸

This process is referred to as emulation. “To emulate a work is to devise a way of imitating the original look of a piece by completely different means.”²⁹ The consideration

²⁷ Walton, Ainsley. "Ainsley Walton, Conservation and Preservation Committee." DOCAM. 2007. Accessed December 11, 2014. <http://www.docam.ca/en/component/content/article/75-comite-conservation-et%20restauration.html>.

²⁸ Vajarakitipongse, Eddy. Telephone interview by author. December 3, 2014.

²⁹ Jones, Caitlin. "Seeing Double: Emulation In Theory And Practice." Annual Meeting of the American Institute for Conservation of Historic and Artistic Works, June 14, 2004, 1-6. Accessed December 11, 2014. <http://cool.conservation-us.org/coolaic/sg/emg/library/pdf/jones/Jones-EMG2004.pdf>.

of the possibility of obsolescence is a crucial policy in preserving works of this type, and having a clear plan in place, that is approved by the artist is a sensible practice.

Joanna Phillips, Time-Based Media Conservator for the Guggenheim Museum advises that “You need good connections, if you are dealing with obsolete equipment.”³⁰ This is demonstrated through conservators collaboration with the photo labs described previously. Additionally, Tina Weidner profiles Adrian Fogarty, whom Tate has contracted to modify and maintain a variety of technologies and devices. Fogarty, a jack-of-all trades engineer, worked with Weidner and Tate Liverpool to realize the installation and exhibition of *Liquid Crystal Environment* by Gustav Metzger. Working with the artist, Fogarty “designed a device that could change the temperature inside a slide projector, regulate the brightness of the lamp and rotate a polarizing filter.” Weidner goes on to describe Fogarty’s proficiency stating “there is no screw on a Kodak S-AV 2050 slide projector that he does not know intimately.”³¹

Fogarty, the Trabantds of Activity Photo Lab, and Albumen Works can be seen as representative of a cottage industry of technicians, engineers, and entrepreneurs who have risen to the challenge of maintaining and modifying technologies that would have long since become obsolete, were they left in the hands of large-scale operations. The same can be said of maintaining the next obsolete technology explored in this paper, Cathode ray Tube monitors.

Cathode Ray Tube Monitors

³⁰ "Interview with Joanna Phillips (part 1/2)." Packed: Center of Expertise in Digital Heritage. May 10, 2010. Accessed December 11, 2014.

http://www.packed.be/en/resources/detail/interview_met_joanna_phillips/interviews/.

³¹ Weidner, Tina.

Cathode Ray Tube (CRT) monitors were the original way of displaying video.³² CRT monitors essentially reversed the capture process of a tube camera, "painting" an electron beam across the inside face of the receiver tube, causing chemical phosphors to glow.³³ A CRT is a sealed vacuum tube, no air is present. An electron gun fires a beam from the back of the tube, which is then deflected by magnetic coils. CRTs were first used in oscilloscopes by Karl Ferdinand Braun in 1897.³⁴ The first Cathode Ray Tube television was later released by the German company Telefunken in early 1930s.³⁵ In 1946, "Peter Goldmark, working for CBS, demonstrated his color television system to the FCC. His system produced color pictures by having a red-blue-green wheel spin in front of a cathode ray tube."³⁶ Today, Color CRT monitors use three electron guns and different phosphors, one for each primary color, to create the illusion of a full color moving image. The phosphors are separated by a metal grille or mask to prevent the intended beam from hitting an unintended type of phosphorus.³⁷ CRT monitors were eventually supplanted by LCD (Liquid Crystal Display) with slimmer and lighter weight technology outselling the original only recently in 2007.³⁸ Sony discontinued production

³² Weise, Marcus, and Diana Weynand. *How Video Works*. Page 79. Amsterdam: Focal Press, 2007.

³³ Weise, Marcus, and Diana Weynand. Page 9.

³⁴ Bellis, Mary. "Television History - Cathode Ray Tube." About.com Inventors. Accessed December 10, 2014.

<http://inventors.about.com/od/cstartinventions/a/CathodeRayTube.htm>.

³⁵ "Telefunken Prewar Sets." Early Television Museum. Accessed December 11, 2014.

<http://www.earlytelevision.org/telefunken.html>.

³⁶ "Historical Periods in Television Technology: 1930-1959." Federal Communications Commission. November 21, 2005. Accessed December 10, 2014.

<http://transition.fcc.gov/omd/history/tv/1930-1959.html>.

³⁷ Kozierok, Charles M. "The Shadow Mask and Aperture Grill." *The Shadow Mask and Aperture Grill*. April 17, 2001. Accessed December 11, 2014.

<http://www.pcguides.com/ref/crt/crtMask-c.html>.

³⁸ Murph, Darren. "Worldwide LCD TV Shipments Surpass CRTs for First Time Ever."

of cathode ray tubes in march of 2008³⁹. The broad period of popular use of CRT monitors, from, roughly, the 1940s to the late 2000s is exceptional, especially when compared to the rapid progression of obsolescence monitors see today. For example, the first full color plasma monitor was produced in 1997, and yet, Samsung and Panasonic discontinued production plasmas sets this year, 2014.^{40,41}

CRT monitors have a lifespan of approximately 20,000 hours.⁴² With this, admittedly robust, but ultimately limited period of functionality, museums are forced to stockpile monitors while they can. For instance, MoMA has a complete backup set of 150 CRT monitors to ensure the lifespan of a single work which requires the monitors as sculptural elements. This sculptural quality qualifies the work as “autographic.” Media conservators have “borrowed this terminology from performance” art to connote works in which the equipment used has essential physical qualities that cannot be changed.⁴³

It is almost impossible to discuss this dilemma of works which feature obsolete display technologies in a way which highlights their physical qualities in a sculptural

Engadget. February 19, 2008. Accessed December 11, 2014.

<http://www.engadget.com/topics/hd/2008/02/19/worldwide-lcd-tv-shipments-surpass-crts-for-first-time-ever/>.

³⁹ "Sony to Stop Making Old-style Cathode Ray Tube TVs." MarketWatch. March 3, 2008. Accessed December 11, 2014. <http://www.marketwatch.com/story/sony-to-stop-making-old-style-cathode-ray-tube-tvs>.

⁴⁰ Mendrala, Jim. "Flat Panel Plasma Display." North West Tech Notes. June 15, 1997. Accessed December 11, 2014. http://www.tech-notes.tv/Archive/tech_notes_004.htm.

⁴¹ Newman, Lily H. "You Won't Be Able to Buy the TVs With the Best Picture Quality Anymore." Slate Magazine. July 2, 2014. Accessed December 11, 2014. http://www.slate.com/blogs/future_tense/2014/07/02/panasonic_and_now_samsung_are_discontinuing_plasma_television_manufacturing.html

⁴² Frohnert, Christine. "Christine Frohnert, "Power On: The Conservation of Electronic Media Art"" Vimeo. February 6, 2013. Accessed December 11, 2014. <https://vimeo.com/59181318>.

⁴³ Frohnert, Christine. "Christine Frohnert, "Power On: The Conservation of Electronic Media Art"" Vimeo. February 6, 2013. Accessed December 11, 2014. <https://vimeo.com/59181318>.

manner without mentioning the work of Nam June Paik. Paik, regularly referred to as the “father of video art,” would often incorporate CRT monitors into larger installation works, sometimes with other materials, to create artworks that often occupied considerable physical space. Due to the autographic nature of Paik’s work, museums elect to “dedicate” equipment to the piece. Dedicating equipment means the equipment is elevated to the level of art, and is tracked, stored and preserved as such. The Guggenheim delineates three categories for its equipment: dedicated, shared obsolete, and non-dedicated equipment. Shared obsolete equipment may be incorporated into several different works, but is not unique to any one work (it was not hand-picked or customized by the artist, for instance), while non-dedicated equipment floats between different artworks unceremoniously and is stored and tracked less formally, in the case of the Guggenheim and LACMA, in a spreadsheet.⁴⁴

Brandenburg Gate (1992) is a work by Nam June Paik that consists of 217 CRT monitors, as well as typewriters, gramophone players and other devices stacked in pillars to resemble the architectural shape of the Brandenburg Gate in Berlin.⁴⁵ As the monitors themselves are part of the architectural structure of the work, “the lifespan of the work is dependent on our ability to repair and service the existing CRTs.”⁴⁶

Just as with slide projectors, building a network of experienced technicians and

⁴⁴ "Interview with Joanna Phillips (part 1/2)." Packed: Center of Expertise in Digital Heritage. May 10, 2010. Accessed December 11, 2014.

http://www.packed.be/en/resources/detail/interview_met_joanna_phillips/interviews/.

⁴⁵ Haberer, Lilian. "Nam June Paik / Brandenburger Gate." New Media Encyclopedia. Accessed December 11, 2014. <http://www.newmedia-art.org/cgi-bin/show-oeu.asp?ID=00002532&lg=GBR>.

⁴⁶ Frohnert, Christine. "Christine Frohnert, "Power On: The Conservation of Electronic Media Art"" Vimeo. February 6, 2013. Accessed December 11, 2014. <https://vimeo.com/59181318>.

engineers, that can provide the high-level of care and consideration that is demanded by museums, is necessary to being able to maintain CRT monitors. MoMA and the Guggenheim enlist the help of DuArt Chief Engineer Maurice Schechter for repair of dedicated CRT monitors in their collections.⁴⁷ Joanna Phillips stated in an interview “I am very grateful for his infinite knowledge and experience, and I am learning from him continuously.”⁴⁸ Specifically for Nam June Paik pieces, Peter Oleksik works with CT Lui of CTL Electronics in Manhattan. CT Lui worked with Paik as the artist built and maintained his works, and has become a de facto restorer of Paik’s work since the artist’s death.⁴⁹ Both MoMA and LACMA work with the Minnesota-based company Dotronix, which sells refurbished CRT monitors and offers repair services on an extensive range of models.⁵⁰ LACMA is considering sourcing their CRT monitors for an upcoming Diana Thater show “where I need 62, 6-2,” Vajarakitipongse emphasized “CRT monitors and these guys are actually able to come true to that.”⁵¹ He added “they all got to match,” highlighting one of the challenges with purchasing large quantities of CRTs for installation. Often a work will require the monitors to be of the same model. It is hard to find large quantities of CRT monitors at all, let alone ones that are all exactly the same.

This is the case with Nam June Paik’s *Video Flag Z* (1986), a grid of 84 CRT monitors which form a sporadic video representation of the American flag, incorporating media from pop culture and American politics. Acquired by LACMA in 1986, the piece was removed from public display in 2000, when the monitors were regularly failing and

⁴⁷ Oleksik, Peter. Interview by author. November 19, 2014.

⁴⁸ "Interview with Joanna Phillips (part 1/2)."

⁴⁹ Oleksik, Peter. Interview by author. November 19, 2014.

⁵⁰ "CRT Monitor Repair, Sales, Parts." Dotronix Technology, Inc. 2014. Accessed December 11, 2014. <http://www.dotronix.com/>.

⁵¹ Vajarakitipongse, Eddy. Telephone interview by author. December 3, 2014.

no replacements could be found. *Video Flag Z* is made up of Quasar Model WP2145H monitors, which were no longer being manufactured. LACMA began a restoration project in 2006, electing to remove the housing of the original monitors and install the cathode ray tubes from similarly sized Triview TCM-1002 CRT monitors. The Triview tubes were fully installed in the Quasar housings by 2011.⁵² Since then, the piece has been exhibited in two separate exhibitions, approximately a cumulative year on display. Eddy Vajarakitipongse observed that:

“Because the newer CRTs were not built as robustly as the previous CRTs, they just didn’t last as long...we started noticing that monitors were dying like one a week, and since we only had so many of the monitors left and the facades were getting brittle, right now I’ve got it packed up. At the moment we’re looking into ways to address two things, the functional monitors and ways to repair them, or buy a whole new lot, and the other thing is to preserve the facades. So, we’re working with different technologies, some new and some traditional to address both of those areas.”⁵³

Vajarakitipongse and LACMA are researching the possibility of 3D scanning the existing housings of the monitors and then 3D printing new housings, as needed. While the original concept for this preservation action was to employ a combination of traditional mold making and 3D printing to save costs, Vajarakitipongse has recently been researching the possibility of 3D printing glass for the front of the housings. “It may

⁵² Gilberg, Mark, Silviu Boariu, Steve Colton, John Hirx, and Jeff Ono. "The Resurrection of Nam June Paik's Video Flag Z." *E-conservation Magazine*. 2007. Accessed December 11, 2014. <http://www.e-conservationline.com/content/view/1104>.

⁵³ Vajarakitipongse, Eddy. Telephone interview by author. December 3, 2014.

be possible to do the whole thing as one whole print," he added.⁵⁴ This too, the "refabrication of an artwork's components," can be seen as an emulation of a work.⁵⁵

As part of his research Vajarakitipongse consults with "friends at JPL [Jet Propulsion Laboratories] and some of the people over at LA Maker Space" on various 3D printing methods and technologies.⁵⁶ The explosion of 3D printing technologies since the 2009 founding of MakerBot, allow for exciting possibilities in to the refabrication of obsolete display technologies.⁵⁷

"Using 3D printing, printing lets say a computer chip or some sort of wiring or something like that, which may not be attractive for a manufacturer to make or provide because its going to be limited to a small quantity and its just not profitable to them...its looking like there are options for printing those things now."⁵⁸

One such example of this is the Voltera "V-One" printer. The printer is a "three-in-one tool: a circuit board printer, a solder paste dispenser, and a soldering oven."⁵⁹ The printer will, then, allow one to create custom circuit boards. Models of circuit boards could proliferate online, and the possibility of a "maker space" community dedicated to refabricating obsolete technologies is certainly within reach. While this by no means

⁵⁴ Vajarakitipongse, Eddy.

⁵⁵ Jones, Caitlin.

⁵⁶ Vajarakitipongse, Eddy.

⁵⁷ Pettis, Bre. "All-Star Lineup Invests in MakerBot." MakerBot. August 23, 2011. Accessed December 11, 2014. <http://www.makerbot.com/blog/2011/08/23/all-star-lineup-invests-in-makerbot/>.

⁵⁸ Vajarakitipongse, Eddy.

⁵⁹ Kokalitcheva, Kia. "Voltera's Circuit Board Printer Wants to Be the 'Makerbot of Electronics'" VentureBeat. November 7, 2014. Accessed December 11, 2014. <http://venturebeat.com/2014/11/07/volteras-circuit-board-printer-wants-to-be-the-makerbot-of-electronics/>.

heralds an end to the problem of replacing equipment that is no longer manufactured, it highlights the ever-changing nature of technology. One's perspective on technology is always limited by the capabilities of technology in a historical moment. New technologies are often seen as utopia-creating devices, or, just as often, the trumpet calling the four horsemen of the apocalypse, while neither is the case.

The flux of technology is a constant. As society adapts and evolves, technology will bend to meet the needs of new cultures and paradigms, which will in turn, inspire changes in society. In this way, culture, and art, are defined by intrinsic philosophical mechanisms inherent in the technologies that produce them. The two cannot be separated. Art is indebted to technology, technology is indebted to art. As technology continues its ever-forward movement, so must art, and the practices of those who preserve it.

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